as about the size of a pea are transported carefully packed in baskets of the leaves of the Pa-la-shu, "white wax tree," which resembles a privet-shrub, and arrive in Szchuan in March, where they are purchased at about twenty taels per basket. The trees by the middle of March have thrown out a number of long tender shoots and leaves, and then the clusters of eggs enclosed in balls of the young leaves are suspended to the shoots by strings. About the end of the month the larvæ make their appearance, feed on the branches and leaves and soon attain the size of a small caterpillar or rather a wingless house-fly apparently covered with white down, with a delicate plume-like appendage, curving from the tail over the back. So numerous are they that as seen by me in Yunnan, the branches of the trees are whitened by them, and appear as if covered with feathery snow. The grub proceeds in July to take the chrysalis form, burying itself in a white wax secretion, just as a silkworm wraps itself in its coccoon of silk. All the branches of the trees are thus completely coated with wax an inch thick, and in the beginning of August are lopped off close to the trunk and cut into small lengths which are tied up in bundles and taken to the boiling houses, where they are transferred without further preparation to large cauldrons of water, and boiled until every particle of the waxy substance rises to the surface; the wax is skimmed off and run into moulds in which shape it is exported to all parts of the Empire.

It would seem that the wax growers find that it does not pay them to reserve any of the insects for their reproductive state, and hence the necessity of importing the eggs from Yunnan. In the district of Ho-chin and Why-li-tzou, where the culture of the eggs is alone attended to, both frost and snow is experienced, so that it would not be difficult to rear the insect in Europe, and considering its prolific nature, the production of white wax might repay the trouble of acclimatizing this curious insect."

INSTRUCTION TO SCIENCE TEACHERS AT SOUTH KENSINGTON.

During the months of June and July, a number of science teachers from various parts of England, Scotland, and Ireland, were assembled in London, for the purpose of attending special classes, arranged for their instruction under the auspices of the Science and Art Department. We propose to give some account of the course of instruction in the principles of Biology

which was directed by Prof. Huxley, to whose suggestion, we believe, liberally accepted by Mr. Forster, and acted upon by the government, this important scheme for raising the character of science teaching in the various schools and classes at present in relation with South Kensington is due. It had long been felt by those who annually examined teachers and pupils for certificates in various branches of science, under the Science and Art Department, that the candidates displayed a sad want of practical acquaintance with the subjects in which they presented themselves for examination: many showed considerable ability and great book knowledge, but a knowledge of the things themselves with which science deals, a proof of personal intercourse with Nature, which after all is the only foundation of scientific knowledge, and without which all the 'ologies are so much book-wormery, was to a very great extent wanting. Under the existing state of things it seemed almost impossible to get out of this vicious condition, for the scholars who were in their turn destined to become teachers were for the most part taught by men who were deficient in practical knowledge; and with the increasing demand for science teaching there appeared to be a probability of the evil being increased by the rapid accession of the book-taught students to the position of instructors. The only way to meet this difficulty was to find teachers who had the requisite familiarity with the "solid ground of Nature," and set them to work to leaven the mass. The readiest means of doing this was undoubtedly that adopted by the authorities — namely, to summon to a central class, the ablest of the teachers at present distributed throughout the kingdom, and to impart to them as much practical acquaintance and personal familiarity with the *things* of which they had read in books, as was possible in a given time. By annual repetition of this plan there can be little doubt that the body of science teachers throughout the country would be materially affected. Being already acquainted with the outlines and much of the detail of their subjects by hearsay, they would readily understand and appreciate the facts and methods of investigating facts placed before them, and after passing through such a course of instruction would be prepared to proceed further in the same direction by their own individual efforts, and what is more important, to teach, not at second-hand, but from experience, not as fluent repeating machines but as thoughtful students of phenomena.

Thirty-nine students of whom one was a lady, attended the course of instruction in the principles of Biology, their expenses (involved in coming to London) being defrayed by the Government. The course occupied six weeks: the students attended every day, with the exception of Sundays, from ten in the morning until half-past four in the afternoon (Saturdays until two). Each morning at ten o'clock a lecture, occupying from an hour to an hour and a half, was given by Prof. Huxley, and the remainder of the day was employed in dissection, microscopic work, and demonstrations, in carrying out which Prof. Huxley was assisted by Prof. Michael Foster, Prof. Rutherford, and Mr. Ray Lankester. The students were placed in pairs at large working tables, and each table was provided with a microscope (with inch and one-eighth inch objectives, and two eye-pieces furnished with micrometric square-ruling), with four scalpels, two pairs of scissors, two pairs of forceps, pins, thread, dissecting needles, watch-glasses, beakers, pie-dishes, glass-tubing, and camel's-hair brush.

The practical instruction proceeded *pari passu* with the lectures, the students at once taking their places at the tables after the lecture, and setting to work at materials provided for them to dissect or examine with the microscope in illustration of, or rather as the sequel to, the lecture which they had just heard. Each student was required to send in full reports and drawings as the result of his day's work, many of which proved very excellent; an abstract of the lecture was also given in by each student with the report of his practical work, and the lot were returned at the end of the course (after due examination by the lecturers) to the students for their future reference.

Two prizes — which were two microscopes similar to those used by the members of the class, and provided like them with inch and one-eighth inch objectives — were offered to the students who should be considered to have done best during the course, especial weight being given to excellence in the practical work, as judged both by observation of the student when at work, and by the reports sent in.

The names of the students were placed in two classes of merit at the termination of the course, arranged in alphabetical order.

Now as to the subjects which were gone over in the time, which though limited to six weeks, yet by dint of hard work, was made to take in more than many a six months' course. The yeast

plant occupied the first lecture and each student was provided with some yeast, which was carefully examined and drawn under the microscope. Each student sowed some in Pasteur's solution which he had himself prepared, and on the following day studied its germination. In like manner the Penicillium mould was studied, sections being cut through the crusts, and careful drawings made of mycelium, hyphæ, conidia, etc. The latter were sown, and their development accurately observed and drawn by each student. A solution of hay was given to each, and the formation of a Bacterium film was studied, the form and movements of Bacteria were compared with the Brownian movements of gamboge rubbed up in water. The structure of the higher Fungi was then studied in specimens of a common toad-stool, and thus a general notion of the morphology and life-history of the Fungi was obtained. Protococcus in its various stages, Palmella, and Volvox next formed the subjects of lectures and practical work, and from these simpler forms the students passed on to Spirogyra and Chara. In Chara the advance in cellular differentiation was noted by each student on specimens supplied to him, and the male and female reproductive bodies examined in detail, and the Antherozooids were obtained in active movement. The phenomenon of cyclosis was also very carefully gone over, each student comparing that of Chara with that seen in Valisneria and in the hair of the nettle and of Tradescantia; drawings and descriptions being made and the specimens prepared by every student for himself. During this time a certain amount of familiarity had been obtained by all with the use of the microscope—not half a dozen of the class, be it remembered, having previously ever used the instrument at all, still fewer one of adequate power—and as well as the instrument itself, the use of various reagents had been learnt, such as iodine-solution for demonstrating starch, and for delineating protoplasm, acetic acid, magenta-solution, etc. From Chara the class proceeded to the study of the Fern—the sori and sporangia were examined in the first place, and the general form of the fern-frond; then each student was provided with spores which had been previously allowed to germinate, of two stages of development, the one set with the quite young pro-embryo-like prothallium, the other more advanced exhibiting numerous archegonia and pistillidia, the structure of all of which were examined and drawn; and in many cases active antherozooids were obtained.

The structure of the fern stem followed, exhibiting typical scalariform, dotted and spiral ducts and other forms of tissue; also the leaf of sphagnum; the methods of recognizing starch and cellulose being here again used. From the fern the class passed on to the study of a bean plant as typical of a phanerogam. Its general morphology, the microscopic structure of its tissues, the minute structure of the flower and the histology of the essential reproductive organs were examined during three consecutive days, and finally the development of the seed and the growth of the young bean plant were studied.

In this work each student used a razor for making sections of the parts to be studied, and portions of turnip were made use of for embedding delicate pieces of tissue, such as leaves, in order to facilitate the cutting of thin sections. A few typical flowers (*e. g.*, Campanula, Rosa, Viola, various Orchids) were next studied as examples of the kind of modification of parts exhibited by phanerogamous plants and also the female flowers of a small Conifer. Before proceeding to the animal kingdom, a lecture was devoted to a retrospect of the steps through which the class had passed from the simple to the more complex forms, a comparison of the various methods of reproduction, and an outline of the physiology of vegetable life.

Amœbæ, the colorless corpuscles of the Triton's blood, and the amœboid particles of Spongilla were the first examples of animal life studied, each member of the class making drawings of the various forms due to protoplasmic movement presented by an individual example of each of these cases of simple organism whilst in the field of his microscope. The Gregarinæ of the earth-worm next occupied a day, and every student was able to observe and draw the actively moving nucleated Gregarina, its simple encysted condition, and its various stages of breaking up into pseudonaviculæ.

The structure of Infusoria was next examined, as exemplified in Vorticella and Vaginicola, the nucleus, contractile vacuole, mouth, etc., being fairly observed and drawn by all the students. Specimens of Hydra were provided, on the following day, and the endoderm and ectoderm, thread-cells and reproductive organs studied. To this followed a copious supply of *Cordylophora lacustris* (from the Victoria Docks), in which the class were able to study a typical compound Cœlenterate, and to recognize not only

the male and female gonophores, but the larval "planula-form" as it escaped from the reproductive capsules. Plumatella as a typical Bryozoon succeeded this, and then two days were given to the dissection and histology of Anodon, of which each student was provided with two or three specimens. The lobster as a typical Arthropod was then examined, a fresh specimen being supplied to each table; the heart and vessels were first studied, then the alimentary canal, liver, reproductive organs and green glands. A large piece of mill-board covered with paper was used by each pair of students for placing out in order, numbering, naming and comparing the twenty somites and their appendages, an instructive preparation being thus made. The corresponding parts were again examined, and the microscopic structure of the muscular tissue, blood, liver, and gills, in specimens of the river cray-fish. The careful dissection of the frog next occupied some days and to this succeeded the rabbit.

Simultaneously with the dissection of these vertebrata, the study of the microscopic structure of the various tissues and organs was commenced, so that whilst one student was using the microscope, his companion at the table was dissecting, and *vice versa*. The blood of the frog and of man, the movements of the colorless corpuscles in both cases, and the action of acids on them, the varieties of epithelium, the various forms of connective tissue and its corpuscles, cartilage, bone, muscular tissue smooth and striped, nerve fibres and cells, the termination of nerve in muscle, and the structure of the more important organs, were examined by the class, *not* in already prepared and mounted "slides," but in specimens which each student took for himself, usually from the animal under dissection, and treated with various reagents, the methods of cutting thin sections and embedding tissues in wax or paraffin being learnt at the same time.

A simple injecting apparatus (formed by two Wolff's bottles and a large vessel of water) was put up, and the method of injecting a frog shown to each student. The best part of a day was spent in a thorough dissection of a sheep's heart, and another in the dissection of the sheep's larynx. Vertical antero-posterior sections of the sheep's head were supplied to the various tables, and in these the parts of the brain and cranial nerves (already made out in the rabbit), the tongue, the relations of the cavities of the mouth, nose, and ear, the ducts of the salivary glands, and the muscles of

the eye were studied. The structure of the eye was again examined by each student, in specimens of those of the bullock, supplied in quantity, and the internal ear and auditory ossicles were demonstrated in rough preparations of the sheep and rabbit.

But little time could be afforded to physiology; and, indeed, it was hardly possible that each member of the class should perform many physiological experiments for himself. The movements of the heart in the frog after excision, and the localization of the nerve-centre, was made out by each student for himself; also the phenomena of reflex action in the frog, after the destruction of the cranial portion of the cerebro-spinal nervous system. Again, each table was supplied with simple galvanic forceps, and the irritation of nerve and of muscle examined, also the action of chemical and mechanical stimuli on the nerve. The action of curare poison on the frog (Bernard's experiment) was examined by every student, and the condition of the poisoned and the unpoisoned leg compared. Every member of the class was made familiar with the simplest way of demonstrating the circulation in the frog's foot, tongue, and mesentery, under the microscope, and repeatedly examined the phenomenon for himself. Rigor mortis and the artificial rigor produced by warm water were examined. The conversion of starch into sugar by the saliva, and the methods of proving the presence of starch and grape sugar, were made the subject of experiment by every individual of the class. The peristaltic movements of the intestine and the absorption of the chyle by the lacteals were exhibited and closely examined. A model of the circulation, consisting of india-rubber tubes and pump, was used for demonstrating the nature of the pulse, the pressure (by means of manometers placed in connection) in the arteries and veins, and the effect of dilatation and contraction of the capillaries and of rate of pulsation on this pressure. Finally, the thorax was opened in a narcotised rabbit and the heart exposed, and each student satisfactorily witnessed the pulsations of that organ and the inhibitory effect of irritation of the vagus nerve; the blood-pressure was exhibited to each member of the class in a similarly narcotised dog by means of the hæmodynamometer, a tube being placed in the animal's carotid artery; and as a concluding demonstration the important fact of the influence of nerves upon gland secretion was demonstrated by the beautiful experiment of Bernard, the chorda-tympana being irritated, whilst a canula was

placed in the duct of the submaxillary gland. Great care was taken that none of the experiments exhibited to or performed by the members of the class should be open to the charge of cruelty, the animals used being either completely narcotised, or (as in the case of the frogs), having the cerebral portion of the nervous system destroyed in the proper manner.

Throughout the course the morning's lecture was made preparatory to or an extension of what was afterwards brought under actual observation. The concluding lecture was devoted to a retrospect of the work which had been gone through, and an exposition of the idea which had guided the scheme of study pursued, the object having been not to make botanists, nor zoologists, nor anatomists of the members of the class, but to give them a practical insight into the structures and activities of living things, in such a way as to enable them to observe for themselves the relations and connections of the various forms of life, and to follow from actual examples the characteristics and increasing complexity of different plans of structure.

The reports of work and lectures daily sent in by the members of the class were entirely satisfactory, and the spirit and enthusiasm displayed throughout proved how greatly the value of the course was appreciated. When it is remembered that with scarcely an exception, these teachers had hitherto never used the microscope, never dissected a single organ or organism for themselves, nor seen one properly dissected, the advantage gained by the experience they have now obtained, even if only a portion of what was condensed into six weeks' work remains with them, is something very considerable, for it is something of a *new kind*, a form of knowledge which they entirely failed to obtain before.

It is exceedingly interesting to find that no difficulty was experienced in going over all these matters in a class which was not confined to men alone, and most heartily do we hope to see in the future a larger proportion of women engaged in this and other branches of scientific study. Those who imagine that women have some innate incapacity, and assert that if admitted to classes now limited to men they would be unable to profit by them, or would hinder the progress of the class by the greater attention they would require in order to keep them to the level of male students, may take this fact to heart—one of the microscopes offered as a prize for the best work done, and the best record of the lectures

and the day's work, was adjudged simply upon the merits of her reports and work to the one lady among the thirty-nine students who formed the class. On the other hand, this fact will probably stimulate that unavowed feeling, akin to the trades-unions' hostility to competition, which is the cause of the arbitrary exclusion of half of the community from our greatest educational institutions. — E. R. L., *in Nature*.

CONTRIBUTIONS TO THE NATURAL HISTORY OF THE VALLEY OF QUITO. — II.

BY PROF. JAMES ORTON.

REPTILES.

THE herpetology of mountain regions is very limited, for the number of species diminishes rapidly as we ascend in altitude or latitude. The reptilian life of any district, however, is highly interesting, as it is more natural and well defined than that of other vertebrates, because reptiles have a limited range* and are less likely to be forced out of their original habitats or introduced by man. It has been supposed that in order of altitudinal range, lizards go highest, snakes next, and batrachians and chelonians last. There are no chelonians in the valley as far as we know; but we found frogs as high up as Antisana Hacienda, and no lizards there. Gibbon found no snakes at La Paz.

The only reptiles which we know to exist in the valley are as follows: *Batrachians*—*Atelopus longirostris* Cope (a new species found by the writer at Antisana Hacienda, thirteen thousand three hundred feet above the sea), *A. lævis* Günth., *Hylodes conspicillatus* Günth., *Bufo intermedius* Günth.; *Ophidians*—*Herpetodryas carinatus* Boie, *Streptophorus Drozii* D. B. An active little lizard (a Pleurodont) occurs in the warm, dry parts of the valley; but we failed to secure a specimen.

FISHES.

Considering the size of the Machangara and Pastassa Rivers

* A remarkable exception is presented by our common Snapping-Turtle, *Chelydra serpentina* Linn., which we found at Guayaquil on the Pacific coast, 2° below the equator.